PCT/IN03/00281

Pom: 8229

THE PATENTS ACT, 1970

IN03/00281

It is hereby certified that annexed hereto is a true copies of Provisional Specification of the extract of Patent Application No. 86/MAS/2003 dated 03/02/2003 by INDIAN INSTITUTE OF SCIENCE, an Indian Company of The Registrar, Indian Institute of Science, Bangalore – 560 012, Karnataka, INDIA.

.....

.....**In witness thereof**

I have hereunto set my hand

Dated this the 23rd day of September 2003
1st day of Asvina, 1925 (Saka)

(K.M. VISWANATHAN)
ASSISTANT CONTROLLER OF PATENTS & DESIGNS

PATENT O[illegible]CE BRANCH
[illegible]VERNM[illegible] OF INDIA
Gu[illegible]ple[illegible]th Floor, Annex.II
No.443, [illegible], Teynampet,
Chennai – 6[illegible]

PRIORITY DOCUMENT
SUBMITTED OR TRANSMITTED IN COMPLIANCE WITH RULE 17.1(a) OR (b)

FORM 1
THE PATENTS ACT, 1970
(39 of 1970)
APPLICATION FOR GRANT OF A PATENT
[See Sections 5(2), 7, 54 and 135 and rule 33A]

1) We, The Registrar, Indian Institute of Science, Bangalore – 560 012, Karnataka State, a Trust, Registered under the Indian Charitable Endowments Act.

2) hereby declare –That we are in possession of an invention titled **"GAS FLOW SENSOR AND ELECTRIC ENERGY GENERATION FROM GAS FLOW.**

(a) That the Provisional Specification relating to this invention is filed with this application.

(b) That there is no lawful ground of objection to the grant of a patent to us.

3) further declare that the inventor(s) for the said invention are

(a) AJAY KUMAR SOOD

(b) Department of Physics
Indian Institute of Science
Bangalore – 560 012
Karnataka State, India.

(c) An Indian

AND

(a) SHANKAR GHOSH

(b) Department of Physics
Indian Institute of Science
Bangalore – 560 012
Karnataka State, India.

(c) An Indian.

4) We claim the priority from the application (s) filed in convention countries, particulars of which are as follows:

(a) Not Applicable
(b) Not Applicable
(c) Not Applicable
(d) Not Applicable
(e) Not Applicable

5) We state that the said invention is an improvement in or modification of the invention, the particulars of which are as follows and of which we are the applicant / patentee:

(a) Not Applicable
(b) Not Applicable

6) We state that the application is divided out of our application, the particulars of which are given below and pray that this application deemed to have been filed on Dt : under Section 16 of the Act.

(a) Not Applicable
(b) Not Applicable

7) That We are the assignees of the true and first inventors.

8) That our address for service in India is as follows :

Mrs. A.V. Nathan, 451, 2nd Cross, 3rd Block, 3rd Stage, Basaveshwaranagar, Bangalore – 560 079, Karnataka State, India.

9) Following declaration was given by the inventor(s) or applicant(s) in the convention country :

We, the true and first inventor for this invention or the applicant(s) in the convention country declare that the applicant(s) herein are our assignee or legal representative.

(AJAY KUMAR SOOD)

(SHANKAR GHOSH)

10. That to the best of our knowledge, information and belief the fact and matters stated herein are correct and that there is no lawful ground of objection to the grant of patent to us on this application.

11. Following are the attachment with the application :

i) Provisional Specification (3 copies).
ii) Drawings 2 sheets (3 copies)
iii) Priority Document(s).
iv) Statement and Undertaking on Form-3.
v) Power of Authority.

Fee Rs. 5000/- vide Cheque No. 597932 dated 01/02/2003.

We request that a patent may be granted to us for the said invention.

Dated this 01st day of February 2003.

(MRS. A.V. NATHAN)
AGENT FOR THE APPLICANT

To

The Controller of Patents
The Patent Office
At Chennai.

FORM 2

THE PATENTS ACT, 1970

PROVISIONAL SPECIFICATION

(SECTION 10)

GAS FLOW SENSOR AND ELECTRIC ENERGY GENERATION FROM GAS FLOW.

WE, THE REGISTRAR, INDIAN INSTITUTE OF SCIENCE, BANGALORE-560 012, KARNATAKA STATE, A TRUST REGISTERED UNDER THE INDIAN CHARITABLE ENDOWMENTS ACT.

THE FOLLOWING SPECIFICATION DESCRIBES AND : NATURE OF THIS INVENTION AND THE MANNER IN WHICH IT IS TO BE PERFORMED.

This invention relates to Gas flow sensor and electric energy generation from gas flow. The invention has applications in a wide variety of fields such as medical instruments, metrology, pollution detection, the automobile industry, aircraft or microscopy.

BACKGROUND OF THE INVENTION:

The available gas flow sensors are as follows:

i) **Particle imaging velocimetry (PIV)**: In this technique aerosol particles are suspended in the gas, and are imaged using fast Charge Coupled Device (CCD). PIV measures the velocity of particles entrained in a flowing fluid across a planar cross section of the flow. A laser light sheet is used to illuminate the small seed colloidal particles. A Charge Coupled Device (CCD) camera is used to electronically record the light scattered from the particles. The image is analyzed to determine the particle separation, and hence the velocity of the particles, which are assumed to follow the path of the flow.

ii) **Doppler velocimetry**: In this technique the flow velocity is measured from the Doppler shift of the scattered light from the gas. As the gas passes through the intersection of two laser beams, the scattered light received from the gas fluctuates in intensity. The frequency of this fluctuation is equivalent to the Doppler shift between the incident and scattered light, and is thus proportional to the component of gas velocity which lies in the plane of the two laser beams and is perpendicular to their bisector.

U.S. Pat. Nos. 3,915,572 and 6,141,086 describe a Laser doppler velocimeter for measuring the velocity of objects or wind such as to ascertain the speed or relative speed of the object such as an automobile or in the case of wind measurement, the true air speed or wind gradients such as wind shear and having reduced cost and weight and increased eye safety.

iii) **Thermal Anemometry:** A thermal anemometer measures fluid velocity by sensing changes in heat transfer from a small, electrically-heated sensor (wire or thin film) exposed to the fluid under study. The heated sensor is held at a constant

temperature using an electronic control circuit. The cooling effect resulting from the fluid flowing past the sensor is compensated for by increasing the current flow to the sensor.

U.S. Patent No. 6,470,741 describes gas flow sensors employing a heated resistance wire, commonly called hot wire anemometers. U. S. Patent No. 6,112,591 describes a high-response, heat-transfer detection type flow sensor which is manufactured by utilizing micro-machining technology for IC production and which has an improved efficiency of heat transfer from a heating element to a heat receiving (sensing) element by controlling the direction of the flow of the gas between the elements or by utilizing the characteristics of the fluid's flow therein.

iv) **The measurement of the differential pressure signal across an integrated fluidic restriction**: The flow rate measurement is done by measuring the differential pressure by two piezo-resistive pressure sensors, signal across an integrated fluidic restriction.

v) **Rotary Flow Meter** : It works on the turbine wheels arrangement: The motion of the gas through the turbine (commonly called the rotor wheel) causes the turbine to rotate. The rotational frequency of the turbine which depends upon the velocity of the gas is measured either by an by an Electro-optical system or by electronically sensing the A square wave pulse is generated by magnets embedded in the vanes of the turbine.

LIMITATIONS OF THE PRIOR ART:

The conventional flow velocity measurement techniques like the particle imaging velocimetry and the Doppler velocimetry uses lasers and detectors, these techniques are thus expensive and requires extensive image analysis. Moreover no direct electrical response is obtained in these techniques. The Particle Imaging velocimetry (PIV) technique is applied to map velocity of low speed flow fields. The drawbacks of this technique are that the seed particles must be small enough to follow flow, and large

enough to be effective light scatterers. It requires extensive image analysis and hence is dependent on analysis algorithms. There is no direct digital signal corresponding to velocity. Flow velocity of pure gas (unseeded) cannot be measured. The requirement of lasers and CCD cameras makes it expensive. Doppler velocimetry requires expensive equipments like lasers and digital counters. Signal level depends on detector solid angle, posing problems of optical access. Thermal Anemometry works on heat balance equations, any small change in the temperature, pressure or composition of the gas can cause erroneous readings. Complicated compensating electronics is used to constantly calibrate the sensor against any change in the environmental parameters, however such correction mechanisms are not fool proof.

SUMMARY OF THE INVENTION:

This invention proposes a device that generates electric current and voltage due to the flow of different types of gases like nitrogen, argon, air etc. over a variety of materials. These materials should be electrically conducting to a fairly good degree and include doped semiconductors, metals, graphite and single wall carbon nanotubes. A schematic layout of the experimental setup to measure the response of the device for different gas velocities is shown in Figure 1 of the accompanying drawings. The magnitude of the electric signal depends on the electronic and thermal transport properties of the device. The said device consists of doped substrate made up from the materials stated hereinabove with appropriate leads connected to a voltmeter to measure the magnitude of the electric signal. The gas can be passed through a tube as shown in figure 1 or any other appropriate means.

Fig. 2 of the drawings illustrates the graph showing the dependence of the generated voltage on gas flow velocity. The magnitude of the signal depends on the square of the gas flow velocity as shown by the filled points in Figure 2.

What has been demonstrated in Figs. 1 and 2 is only by way of example and the same is in no way restrictive of the invention. The said figure is intended to illustrate the implementation and advantages of the invention.

ADVANTAGES OF THE PRESENT INVENTION:

The device of the present invention is a fast response, gas velocity flow sensor over a very wide range of velocities. The device gives a direct electrical response to the gas flow, which will have immense use in control electronics. The device can be fabricated in micrometer to nanometer dimensions. These flow sensors in series and parallel combinations will also be used as energy conversion devices allowing them to be used as voltage or current sources. The said design results in considerable cost savings with its simple installation and energy efficient design, providing a viable alternative to traditional flow measuring devices. The energy conversion device does not have any moving part, which is a big advantage.

DATED THIS 01ST DAY OF FEBRUARY 2003.

(MRS. A.V. NATHAN)
AGENT FOR THE APPLICANT

TO

THE CONTROLLER OF PATENTS
THE PATENT OFFICE,
AT CHENNAI.

ABSTRACT

Described herein is a Gas Flow Sensor and Electric Energy Generation from Gas Flow. The said gas flow sensor generates electric current and voltage due to the flow of different types of gases like nitrogen, argon, air etc. over a variety of materials which are electrical conductors.

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NO. OF SHEETS - 02
SHEET NO. 01

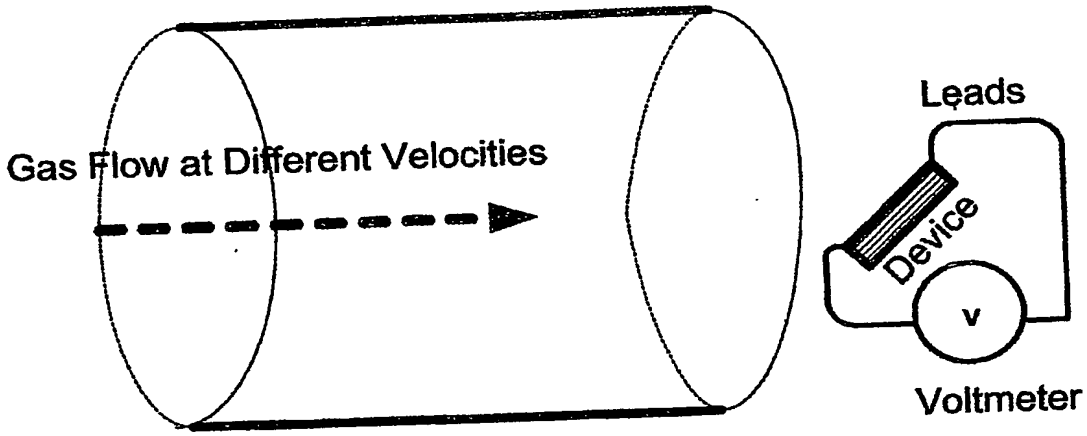

FIG-1

A.V. Nathan
(MRS. A.V. NATHAN)
AGENT FOR THE APPLICANT

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SHEET NO. 02

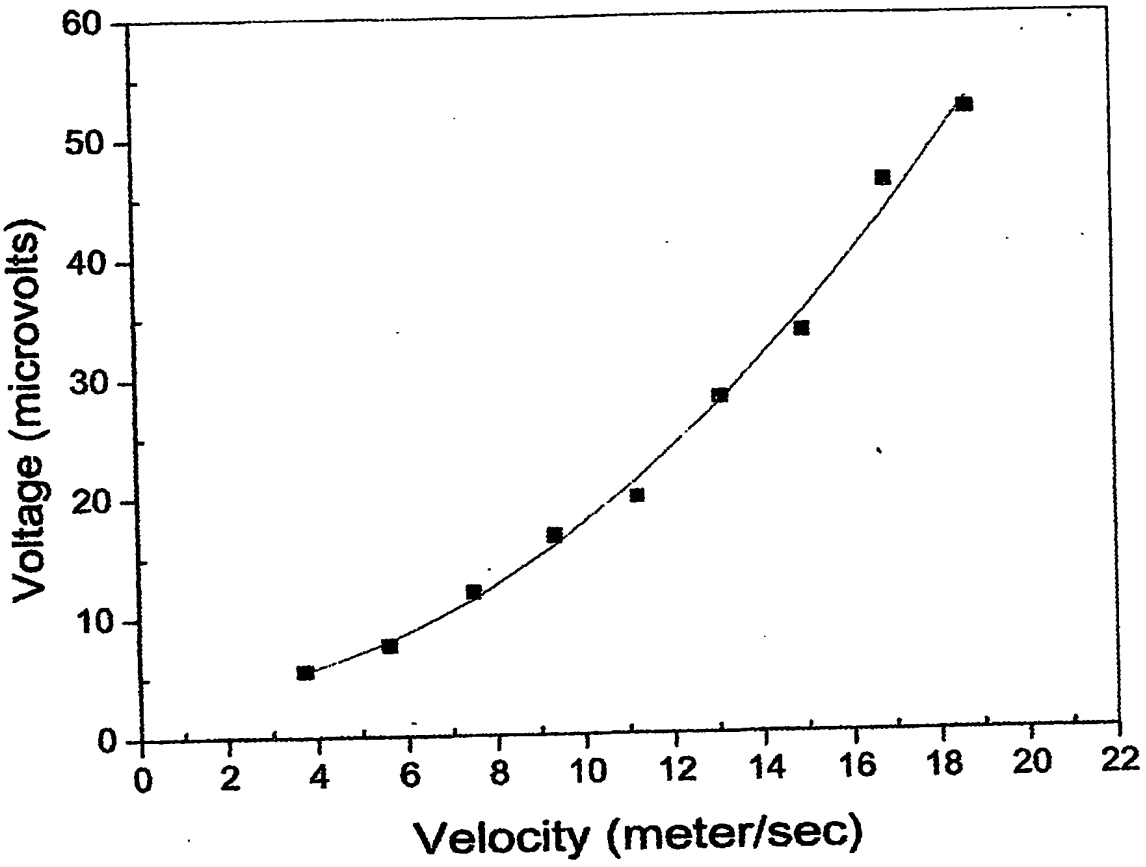

FIG-2

Acrnathan

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